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THE SECOND THEOREM OF THE SECOND BEST

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Until recently, neoclassical economists believed that the essential properties of equilibrium were independent of the distribution of wealth. In particular, they believed that the distribution of wealth would not influence the set of markets that were feasible, or the set of technologies that could be implemented.

Theoretical work in a variety of fields of economics has recently found that this "separability" result breaks down in economies where information is imperfect. For example, whether a borrower or a lender, or purchaser and supplier, can design a contract to get around an information asymmetry or the absence of third-party enforcement of contracts may depend on the level of wealth of the prospective borrower, purchaser, or supplier. And the possibility that certain contractual relationships are feasible in turn will affect the technologies and resources on which an economy can draw.

There is no general statement in the literature of the influence of the distribution of wealth on the efficiency of production and exchange in a market economy. Perhaps for that reason, many economists continue to assert that a pure wealth redistribution can neither create nor remove distortion, even though that "theorem" can only be proved for the special case where no informational or other barriers impede perfect markets and perfect enforcement of contracts. That case is far removed from the situation in which most developing countries find themselves: Risk markets are typically absent and third-party enforcement of contracts is often not available.

This paper presents the general theorem that in economies where there exist barriers to exchange arising from asymmetric information in the market or for other reasons, piecemeal welfare analysis of the distribution of wealth is not possible. In general, wealth redistributions will affect the technologies and the labor and human capital resources on which an economy can draw. The paper then illustrates the theorem with examples of information problems in credit and labor markets. In some examples, information problems between individuals in a market economy are shown to strengthen the case for a more equal distribution of wealth, while in others they weaken the case. The examples also serve to illustrate three distinct forces through which a transfer of wealth affects the feasibility of a contract or exchange. These forces depend on, respectively, countervailing incentives, enforcement rents, and hostage-taking.

The second theorem of the second best

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This paper interprets many results from the literature on incentive compatibility and cost–benefit analysis as illustrations of a second theorem of the second best. The theorem states that if there exists any restriction on transactions required for first-best efficiency, then there is no presumption that a social welfare maximum entails equal marginal social utilities of income across individuals. One reason is that incentive constraints shift with redistributions of wealth, so that redistributions have an instrumental role in relaxing constraints that make the economy second best. Two examples relate such wealth effects to *countervailing incentives* and *hostage-taking*.

1. Introduction

The famous theorem of Lipsey and Lancaster (1956–1957) states that there may be an efficiency role for distortionary taxes provided that there are any pre-existing distortions in the economy, but it says nothing about lump-sum income distributions. There is a small literature in cost–benefit analysis that identifies an efficiency role for lump-sum transfers in the presence of exogenous distortions, where lump-sum transfers change aggregate demands.[1] This paper interprets these results from cost–benefit analysis, together with recent results from the literature on incentive compatibility that establish an efficiency role for lump-sum transfers, as illustrations of a

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[1]Suppose, for example, that household h has a higher income elasticity of demand than household ℓ for all goods with market price above social marginal cost (e.g. for all goods subject to commodity taxes). Then a social welfare maximum will not entail equating their social marginal utilities of income. Starting from an initial distribution where the social marginal utility of income is the same for both households, a transfer of \$1 from ℓ to h will increase social welfare by freeing additional resources for consumption or investment. See Atkinson and Stiglitz (1980, p. 387, eqs. 12-54a and 12-55), and Drèze and Stern (1987, eqs. 2.23, 2.30, and 3.12), and references therein.

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second theorem of the second best. The latter results are not driven by income effects on consumer demand. Instead, they are driven by wealth effects on the barriers to exchange arising from asymmetric information. Private information limits the set of allocations that can be reached in a market economy; and *incentive compatibility* constraints, which are derived from the primitives of the information structure, may shift with even small redistributions of wealth. By this means, lump-sum transfers may affect the organization of an economy – its set of markets and the feasible set of exchanges within markets – on which production and exchange efficiency depends.

No formal statement of this principle seems to exist, and the principle is often forgotten. For example, in the *Handbook of Public Economics*, Robert Inman (vol. 2, 1987, p. 757) states without qualification: 'When lump-sum taxes and transfers are available, redistributive induced inefficiencies ... will be zero.' I view the task of this paper as one of integration: unifying results from seemingly quite different models in the literature on incentive compatibility and cost–benefit analysis into a single picture.

The proposed second theorem of the second best states that if there exist restrictions on transactions required for first-best Pareto efficiency – restrictions that can arise from asymmetric information among private economic agents, limitations on the instruments at the disposal of government, or for other reasons – then the marginal equalities that describe the optimal distribution of wealth will, in general, also be changed. 'Piecemeal' welfare analysis of the distribution of wealth is not possible. Even if lump-sum taxes are available, to use them to distribute wealth in a way that equalizes the marginal social utility of income across individuals may well diminish the productive efficiency of the economy and social welfare.

Section 2 states and proves the theorem, while sections 3 and 4 apply it to two formal models from the literature on incentive compatibility. The examples are chosen to illustrate two distinct reasons why lump-sum transfers may shift incentive constraints: *countervailing incentives* and *hostages*. Section 5 draws together the main implications of the examples and briefly discusses two models (with non-altruistic individuals) where redistributions yield Pareto improvements. That is, in taking from Peter and giving to Paul, both Peter and Paul become better off! Section 6 applies the second theorem of the second best to a problem of the optimal supply of public goods and to a problem in development economics, and section 7 concludes.

2. The second theorem of the second best

Theorem. If there is introduced into the problem of maximizing social *welfare*[2] $S(\ldots, U^c(x_1^c,\ldots,X_G^c),\ldots)$ *subject to a transformation function* $F(x_1,\ldots,x_G)=0$ *a 'second-best constraint'* $U_i^a/U_j^a - k(x_1^a,\ldots,x_G^a)F_i/F_j=0$ *for some goods i and j, some consumer a, and* $k \not\equiv 1$, *then any interior social welfare optimum will be characterized by either*

(a) *a violation of the first-best distribution conditions,* $S_a U_g^a = S_c U_g^c$, *for* $c=1,\ldots,C$ *and an arbitrary good g,*

or

(b) *invariance of the second-best constraint to a marginal redistribution of the good across consumers, that is,*

$$\frac{\partial(U_i^a/U_j^a)}{\partial x_g^a} - \frac{\mathrm{d}k}{\mathrm{d}x_g^a}\frac{F_i}{F_j}=0.$$

Proof. The social welfare optimum is the solution to the Lagrangian

$$\max L = S(\ldots, U^c(x_1^c,\ldots,x_G^c),\ldots) - \lambda F(x_1,\ldots,x_G).$$

The necessary conditions for a maximum, ignoring corner solutions and indivisibilities, are

$$S_c U_g^c - \lambda F_g = 0, \quad \text{for } c=1,\ldots,C \text{ and } g=1,\ldots,G,$$

which dichotomize into a set of distribution (or interpersonal optimal) conditions for an arbitrarily chosen good, say good 1:

$$S_a U_1^a = S_c U_1^c, \quad \text{for } a,c=1,\ldots,C, \tag{1}$$

and a set of Paretian conditions:

$$\frac{U_i^c}{U_j^c} = \frac{F_i}{F_j}, \quad \text{for } c=1,\ldots,C \quad \text{and} \quad i,j=1,\ldots,G. \tag{2}$$

We wish to check whether (1) continues to characterize the welfare optimum when one of the Paretian conditions cannot be attained.

Assume that incentive constraints or restrictions on government policy prevent the attainment of (2) for at least one consumer, say a:

$$\frac{U_i^a}{U_j^a} = k(x_1^a,\ldots,x_G^a)\,\frac{F_i}{F_j}, \tag{3}$$

with $k(\cdot) \not\equiv 1$. The resulting social welfare problem is

[2]Superscripts indicate the consumer, $c=1,\ldots,C$, and subscripts on x indicate goods, indexed by $g=1,\ldots,G$. Let $x_g = \sum_c x_g^c$ and let subscripts on the functions $S(\cdot)$, $U^c(\cdot)$, and $F(\cdot)$ indicate partial derivatives, i.e. $U_g^c \equiv \partial U^c/\partial x_g^c$.

$$\max L = S - \lambda' F\gamma[U_i^a/U_j^a - kF_i/F_j].$$

γ cannot always be zero since that contradicts (3).

Denote second-order partial derivatives with two subscripts, so that $\partial^2 U^c/\partial x_i^c \partial x_g^c \equiv U_{ig}^c$. Necessary conditions for an interior social welfare optimum now take the form, for $g=1,\dots,G$,

$$S_a U_g^a - \lambda' F_g + \gamma k R_g = \gamma \left\{ \frac{U_{ig}^a U_j^a - U_{jg}^a U_i^a}{[U_j^a]^2} - \frac{\mathrm{d}k}{\mathrm{d}x_g^a}\frac{F_i}{F_j} \right\} \tag{4}$$

and

$$S_c U_g^c - \lambda' F_g + \gamma k R_g = 0, \quad \text{for } c=1,\dots,C \text{ but } c \neq a, \tag{5}$$

where $R_g \equiv [F_j F_{ig} - F_i F_{jg}]/[F_j]^2$.

Eqs. (4) and (5) apply to all goods, so they apply to the case $g=1$. If the first-best distributional conditions (1) are satisfied, then the left-hand sides of the two equations are identical and equal to zero, and so the right-hand side of (4) equals zero, as was to be shown. □

Many people have observed that, given second-best constraints of the form $MRS = k \cdot MRT$, with k exogenous, lump-sum redistributions can affect efficiency through playing on the MRS (see references in fn. 1). The main contribution of this paper is to show that it is a general result, which operates for a variety of reasons, that in second-best constraints arising from private information among transactors in a competitive economy, *k will depend on the distribution of wealth.* The examples in the next two sections are rigged in the sense that the MRS values are independent of the distribution of wealth, and the social marginal utility of consumption is a constant,[3] so that redistributions can increase social welfare *only* if they reduce the deviation of k from unity. Under these assumptions, condition (a) of the theorem never holds, and the theorem implies that at an interior social welfare optimum, a numeraire good g will be distributed toward or away from type a to satisfy the condition $\mathrm{d}k/\mathrm{d}x_g^a = 0$ (see the example in section 3). In the example of section 4, it is assumed that types are not observable to government, and I show that the incentive constraint puts bounds on the level of inequality consistent with a maximum of social welfare.

3. Countervailing incentives

It is well known that residual claimancy can solve any problem of private

[3]Formally, the assumptions are of (a) identical and homothetic preferences, and (b) a social welfare function where eq. (1) always holds.

information. Let the investor be the residual claimant to his wealth in every state of the world, let the farmer pay a fixed rent rather than work as a sharecropper, let each worker be self-employed, and agency costs are eliminated.[4] It would therefore be trivial, in a model in which risk-neutral entrepreneurs have private information about investment projects, to show that agency costs are eliminated if entrepreneurs are each endowed with enough wealth that bankruptcy never occurs and the entrepreneur is the residual claimant to his output in every state. What Bernanke and Gertler's (1990) model shows is that complete residual claimancy is not necessary to eliminate agency costs. If their example economy, entrepreneurs have to rely on external finance and have a positive probability of default. Nevertheless, there is a level of endowment wealth, $\bar{W}$, such that if every entrepreneur's endowment is at least $\bar{W}$, agency costs are zero and the economy is first best. This example also shows that *marginal* changes in an entrepreneur's wealth below $\bar{W}$ exacerbate agency costs, and that there may exist a strictly positive level of endowment wealth such that if an entrepreneur's endowment is below this, agency costs are prohibitively high and he will not undertake any project.

Consider an economy where a non-consumable input good is allocated between a safe asset with a gross rate of return r, and a set of risky projects. The safe asset is divisible but each risky project requires one unit of the input good. Individuals are of two types – entrepreneurs who are each able to undertake one risky project, and non-entrepreneurs who can undertake none. Each entrepreneur's endowment of the input good, W^{E}, is less than one. The aggregate endowment of the input good exceeds the number of entrepreneurs. Individuals maximize their expected income less effort, $\mathrm{E}y-e$.

A risky project yields a gross return R if it succeeds, and 0 otherwise. The quality of a risky project is defined by its success probability, p. p itself is a random variable drawn from a cumulative distribution function $H(p)$, which is common knowledge. Undertaking a risky project requires that the entrepreneur first invest effort to evaluate it at a utility cost e. Without evaluation, a project cannot succeed. With evaluation, the entrepreneur learns how to manage the project and its probability of success. If its success probability is below some reservation rate, denoted p^*, then he rejects the project and invests his endowment in the safe asset. If he accepts the project (because he finds $p \geqq p^*$), he will seek external finance in the amount $1-W^{\mathrm{E}}$. For future use, define $\hat{p}$ as the expected success probability of any project undertaken by an entrepreneur with reservation success probability p^*, i.e.

$$\hat{p}(p^*)=\mathrm{E}\{p \mid p \geqq p^*\}.$$

[4]At some, perhaps very large, cost in unexploited gains from specialization, returns to scale, and the spreading and pooling of risk.

state u where the project fails, and state s where it succeeds. Contingent on each state of the world, the entrepreneur's final wealth is the vector $\langle rW^{\mathrm{E}}-Z_0, -Z_u, R-Z_s\rangle$. By making Z_0 sufficiently negative,[6] the lender could induce an entrepreneur to set p^* arbitrarily high[7] and, in particular, could induce him to choose the first-best Pareto-efficient point, p^*_{fb}. That is, the entrepreneur's borrower-like incentive to gamble on a negative present value project (because if the gamble is successful, he wins, and if not, the lender loses) could be offset by his incentive not to risk his income $rW^{\mathrm{E}}-Z_0$. A negative value for Z_0 *countervails* his borrower-like incentive to undertake a risky project, where the term is due to Lewis and Sappington (1989).

But the scope for using countervailing incentives depends on the entrepreneur's endowment wealth. As $-Z_0$ becomes large, the entrepreneur loses any incentive to evaluate a project [see eq. (A.4) or (A.4′) in the appendix]. The need to preserve the entrepreneur's incentive to evaluate a project thus limits how high $-Z_0$ and hence, p^* can be raised. Since what induces greater selectivity on the entrepreneur's part is his total opportunity cost of undertaking a project, $rW^{\mathrm{E}}-Z_0$ [see eq. (A.5)], it is intuitive that only if the entrepreneur's endowment wealth is sufficiently high can p^* equal p^*_{fb} under the Pareto-efficient contract. Formally, we have:[8]

Proposition 1. If an individual's type (entrepreneur or non-entrepreneur) is observable, then in a competitive economy there will exist a value of endowment wealth strictly less than one, denoted $\bar{W}$, *such that if, and only if,* $W^{\mathrm{E}}\geqq\bar{W}$, *no incentive constraint binds and* $p^*=p^*_{fb}$. *If the cost of evaluation, e, is sufficiently high, there will also exist a strictly positive value of endowment wealth, denoted* $\underline{W}$, *such that if* $W^{\mathrm{E}}<\underline{W}$, *incentive constraints bind so tightly that no intertemporal trade occurs. If* $\underline{W}<W^{\mathrm{E}}<\bar{W}$, *then intertemporal trade occurs but* $p^*<p^*_{fb}$*; in this case,* $\mathrm{d}p^*/\mathrm{d}W^{\mathrm{E}}>0$.

The transformation function of the economy can be written as $F(Y_1, Y_2; T, \sum W)=0$, where Y_1 is output produced using the safe technique, Y_2 is expected output produced using the risky technique, T is time that can be devoted to leisure or project evaluation, and $\sum W$ is the aggregate endowment of the input good. Suppose that $\underline{W}<W^{\mathrm{E}}<\bar{W}$ for the marginal entrepreneur. Then the MRS between Y_1 and Y_2, being equal to one, is more than the MRT, that is

[6] $-Z_0$ is the amount that the entrepreneur *receives* from the lender in the event that he undertakes no project. A pure debt contract at interest i where the debtor defaults if the project fails is the payment vector $\langle 0, 0, [1+i][1-W]\rangle$.

[7] By inspection of the first-order condition for p^* in appendix equation (A.5), $\partial p^*/\partial(-Z_0)$ is always strictly positive and bounded away from zero.

[8] This proposition summarizes Bernanke and Gertler's results for what they call 'the case of observable types'. This is not the central case analyzed in their paper, and they provide only hints of a proof of these results. I provide a proof in the appendix.

$$\frac{\mathrm{d}Y_2/\mathrm{d}W}{\mathrm{d}Y_1/\mathrm{d}W}=\frac{p*R}{r}<1.$$

In terms of the general expression for a second-best constraint, $MRS=k{\cdot}MRT$, we have $k=r/[p^*(W^{\mathrm{E}})R]>1$, where p^* is evaluated for the marginal entrepreneur. In words, the value of Y_1 exceeds its social cost; the safe technique is under-exploited. From Proposition 1, $\mathrm{d}p^*/\mathrm{d}W^{\mathrm{E}}>0$ for $\underline{W}<W^{\mathrm{E}}<\bar{W}$, so it follows that $\mathrm{d}k/\mathrm{d}W^{\mathrm{E}}<0$.

It is now straightforward to characterize the optimal wealth distribution. Assume a utilitarian social welfare function, $S=\sum U^i$. Differentiating (A.1) in the appendix yields the marginal utility of wealth to an entrepreneur:[9]

$$\mathrm{d}U^{\mathrm{E}}/\mathrm{d}W^{\mathrm{E}}=r+[\mathrm{d}p^*/\mathrm{d}W^{\mathrm{E}}]h(p^*)\,[r-p^*R],$$

where $h(\cdot)$ is the density function of p. For a non-entrepreneur $U^N=rW^N$, so $\mathrm{d}U^N/\mathrm{d}W^N=r$. Subtracting the second expression from the first yields the social welfare gain from a marginal lump-sum transfer, $\mathrm{d}W$, from a non-entrepreneur to an entrepreneur:

$$\mathrm{d}S=\begin{cases}[\mathrm{d}p^*/\mathrm{d}W^{\mathrm{E}}]h(p^*)\,[r-p^*R]/\mathrm{d}W>0, & \text{if } \underline{W}<W^{\mathrm{E}}<\bar{W},\\ 0, & \text{otherwise.}\end{cases}$$

The gain from the redistribution is larger, (i) the greater the shift in the incentive constraint, as measured by $\mathrm{d}p^*/\mathrm{d}W^{\mathrm{E}}$; (ii) the greater the probability mass, $h(p^*)$, of projects that would be rejected with a marginal increase in the entrepreneur's endowment; and (iii) the greater the excess of the safe return over the expected return on the marginal project in the initial equilibrium, $r-p^*R$. At an interior maximum, $\mathrm{d}S=0$, so that $\mathrm{d}p^*/\mathrm{d}W^{\mathrm{E}}=\mathrm{d}k/\mathrm{d}W^{\mathrm{E}}=0$, as the theorem's condition (b) implies.

Fig. 1 summarizes these results. It traces the expected utility possibility frontier between a representative entrepreneur and a representative non-entrepreneur. A wealth redistribution that increases the entrepreneur's endowment above $\underline{W}$ gives him access to external finance on attractive terms and thereby makes possible exploitation of the risky technology, one that increases it within the range $(\underline{W}, \bar{W})$ mitigates the problem of over-investment in the risky technology, and one that raises it above $\bar{W}$ permits a first-best allocation where no incentive constraint binds.

4. Hostages

This section might more aptly be called, 'Reducing hostage-taking', and it illustrates a second channel through which lump-sum transfers affect the

[9]We substitute (A2) into (A1) and then use the fact that by the definition of $\hat{p}$, $\mathrm{d}\hat{p}/\mathrm{d}p^*=h(p^*)\,[\hat{p}-p^*]/[1-H(p^*)]$.

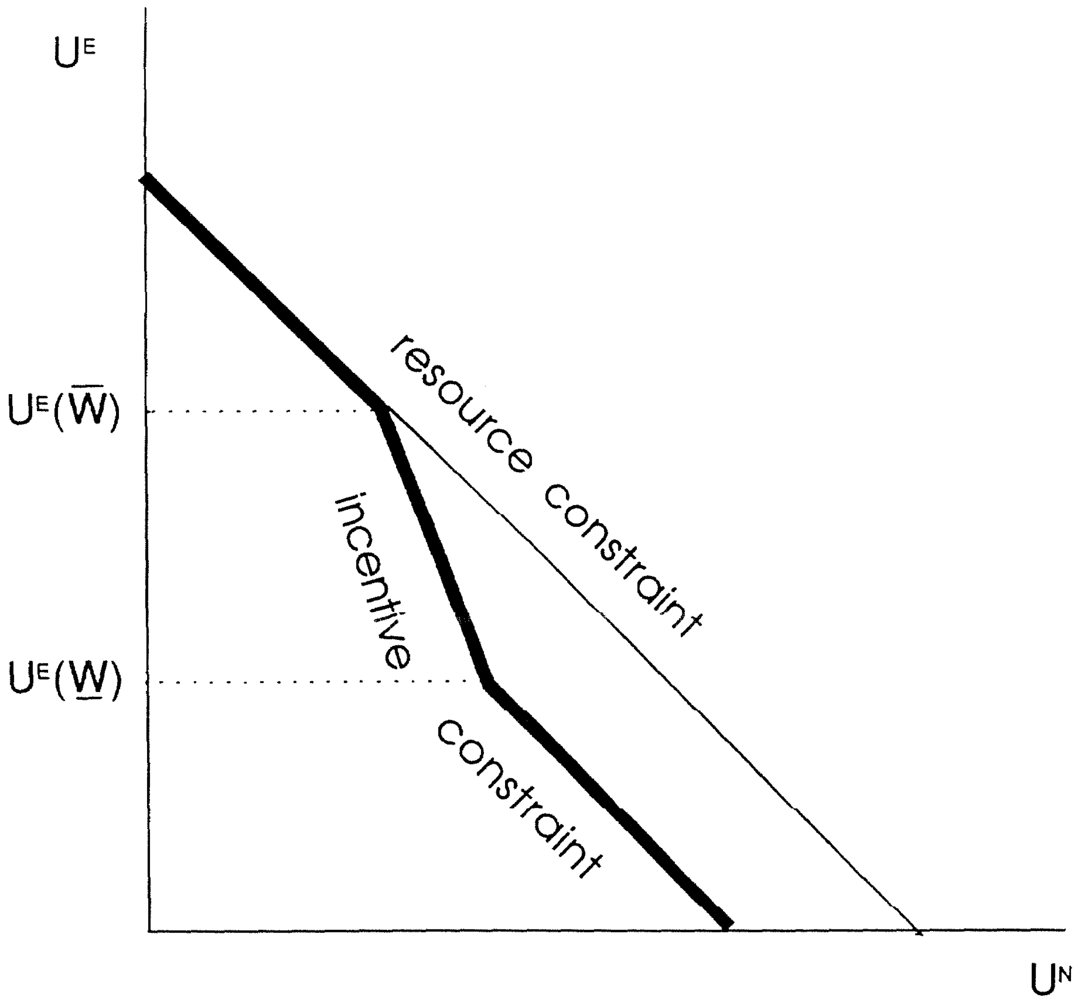

Fig. 1

performance of markets. A characteristic of many long-term contracts is that one party ('A') makes a sunk investment in another ('B') – an investment in training or capital that cannot be recouped unless the relationship continues. Once A makes the investment, B has an incentive to threaten to walk away from the relationship unless the terms are renegotiated in his favor. The sunk cost is a hostage that B can use to 'hold up' A. When such hostage-taking is possible, A will have no interest in entering the relationship.

The example in this section is due to Hart and Moore (1991).[10] They assume that there is no information asymmetry between the transactors, but that their information is not accessible to third parties. Hence, they cannot

[10]The example does not precisely fit the assumptions under which the theorem was proved because the incentive constraint is not differentiable, but it does illustrate the general result that the scope of markets depends on the distribution of wealth. For examples of hostages in a variety of markets, see Williamson (1983).

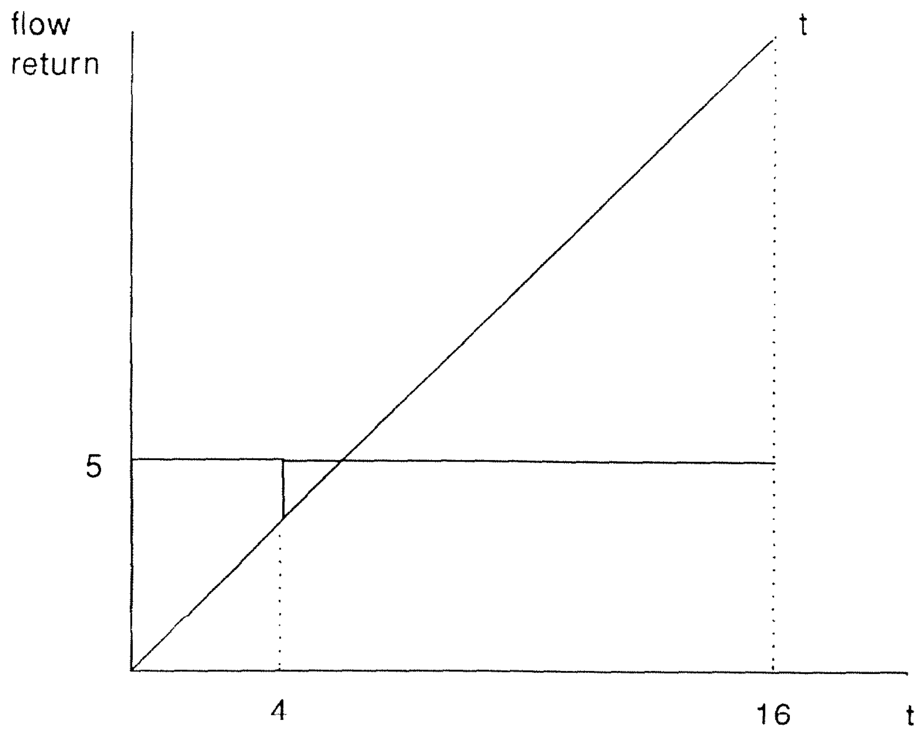

Fig. 2

rely on third-party enforcement to prevent hold-up. It is shown that B can credibly promise not to hold up A if, and only if, B has sufficient wealth.

B is an individual who has human capital that permits him, if he obtains control over a physical asset, to obtain the flow return $r(t)$, where

$$r(t)=\begin{cases} t, & \text{if } t \leqq 16, \\ 0, & \text{if } t > 16. \end{cases}$$

See fig. 2. The asset's flow return to a user without human capital is only 5 per unit time over the same period, as shown in the figure. The physical asset costs 80 (that is, 5×16). There is no market for human capital, but there is a financial market that is ex ante (before contracts are signed) perfectly competitive with rate of return normalized at zero.

The financial market relies solely on the threat of liquidation to enforce financial contracts. (This assumption is most realistic where the costs of litigation are very high.) In the event of default, the debtor's physical wealth passes to the financier. The financier can then either liquidate or renegotiate a new financial contract with the debtor. If the financier liquidates at time t, he obtains a price $5[16-t]$ for the physical asset. Suppose that the outcome of any renegotiation is a 50–50 split between financier and debtor of the return, $\int_t^{16} \tau \, dt$, over the remaining life of the physical asset. At any time t the financier will then prefer liquidation over renegotiation if, and only if, $5[16-t] > \frac{1}{2}\int_t^{16} \tau \, d\tau$, which requires $t<4$. After $t=4$ the financier has no incentive to enforce the initial contract.

Since at $t=4$ the outcome of a renegotiated settlement would be 60, promises to repay more than 60 after $t=4$ are not credible. It follows that by $t=4$ the debtor must have invested 20 (that is, $80-60$) of his own resources in the physical asset. But to invest 20 over the initial four years of the project, the debtor must have private wealth equal to 12, the shaded area in fig. 2. If he does not, he cannot credibly promise to repay the loan he needs to obtain the physical asset. As in the preceding section, the credit market shuts down if those who would wish to borrow are sufficiently poor.

To see formally how the second theorem of the second best applies to this economy, let X be output produced by capital owned by an individual endowed only with physical capital (denoted W^x). Let Y be output produced by capital owned by an individual with human capital as well as with physical capital in the amount $W^y = 12-\varepsilon$. Then $dX/dW^x = 1$, whereas Y jumps discontinuously above 1 with an increment ε in the wealth endowment of the second person. The MRS between Y and X, being equal to one, exceeds the opportunity cost of producing one more unit of Y, which approaches zero as ε approaches zero. Equality between MRS and MRT requires that each individual with human capital be endowed with at least 12 units of physical capital.

Recalling that third parties cannot observe an individual's type and actions and thus, in particular, cannot observe his human capital, from the perspective of government each individual's endowment consists of a random component of human capital (one or zero) plus some amount of physical capital. The utility possibility frontier for any two individuals will have the form shown in fig. 3. An increase in an individual's physical endowment above $12-\varepsilon$ gives rise to a discontinuous jump in ex ante welfare by permitting him to use an endowment of human capital. If per capita physical wealth is at least 12, then at the (first-best) social welfare optimum each individual's endowment will also be at least 12, and the incentive constraint will not bind.

5. Discussion and examples of Pareto-improving redistributions

The main implications of the preceding examples are the following:

(1) The extent to which an information asymmetry between a principal and agent gives rise to agency costs depends on the distribution of wealth through its effect on *countervailing incentives.*[11]

[11] See also Sachs (1989) and, for a related problem in bargaining theory, Cramton et al. (1987).

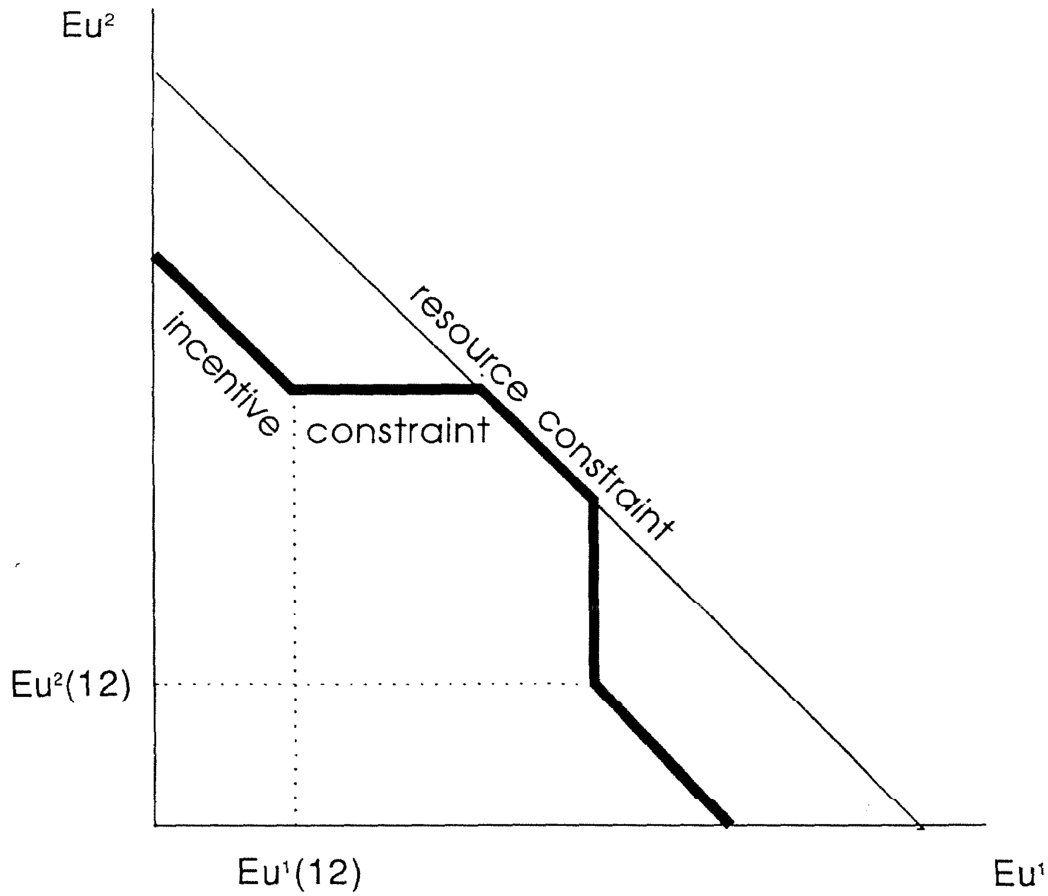

Fig. 3

(2) Whether there exists a contract that can get around the absence of third-party enforcement depends on the distribution of wealth through its effect on the scope for *taking hostages* (as in Hart and Moore) or *offering* hostages [see Williamson (1983)].

(3) The distribution of wealth affects the production set through its effect on the technical efficiency with which inputs are allocated, the feasible set of technologies, and the aggregate human capital and labor force on which the economy can draw.[12]

[12]For economic evidence, see, for example, Hubbard and Kashyap (1992). For an exploration of the implications for long-run growth, see Banerjee and Newman (1993), where an initial wealth distribution influences the set of binding incentive constraints and, hence, household incomes, bequests, and incentive constraints in subsequent periods and in the steady state.

The contracting problems with which these examples have been concerned are two-person contracts. Recent research, motivated by problems of providing credit to the poor, has shown that group incentive schemes can sometimes yield Pareto improvements by reducing agency costs [see Stiglitz (1990) and Varian (1990)]. In such incentive schemes, each member suffers a penalty for contract non-performance by any other member of the group, whom he can easily observe and on whom he exerts social pressure to uphold the contract. In this way the group makes promises to repay credible. Such schemes, in general, impose a real cost: they transfer risk to individuals and away from the financial sector, which has a comparative advantage in bearing risk. But they hold promise in relaxing the incentive constraints that low wealth combined with incomplete information would otherwise impose.

A characteristic of the examples in sections 3 and 4 is that wealth redistributions moved us along a constrained Pareto-efficient frontier. But that is not a general result. Binding incentive constraints imply that markets are incomplete, and by expanding a market there can be scope for Pareto improvements. I will mention two examples briefly. First, in an exchange economy with at least two goods in each state of the world, Geanakoplos and Polemarchakis (1986) show that a transfer, before uncertainty is resolved, that reduces the endowment of one set of agents and increases the endowment of another set, can strictly increase the expected utility of all agents [see Charles Wilson (1987) for a simple illustration]. The transfer affects the distribution of spot prices. The change in the distribution of spot prices provides a partial substitute for the missing risk market, and thereby makes all parties better off.

Second, Hoff and Lyon (1993) consider a model related to that of Bernanke and Gertler and show that a policy that taxes labor income, the proceeds of which are redistributed back to individuals not according to the amount paid but in equal, lump-sum amounts, is Pareto improving. This is an interesting result since individuals are risk neutral. The lump-sum grants provide individuals a riskless source of income that can be used as collateral against debt. The increase in collateral improves the average quality of borrowers who are of heterogeneous quality but observationally identical, and thereby reduces the externalities that high-risk borrowers impose on low-risk borrowers. The policy is a Pareto improvement because at the beginning of his life, an individual does not know the investment opportunities that he will have.

The second theorem of the second best turns on the effect that a lump-sum transfer may have in relaxing a second-best constraint. It implies a breakdown of the neat dichotomy between distribution and efficiency in the neoclassical model. But this dichotomy may break down for other reasons, where the second theorem of the second best need not apply. Such is the case of *enforcement rents* [see, for example, Klein and Leffler (1981), Shapiro and

Stiglitz (1984) and Bowles and Gintis (1988), who coined the term]. When a buyer and seller expect to engage in repeated transactions, an *enforcement rent* is a payment for a commodity above the seller's reservation price that substitutes for a monitoring mechanism. By giving the seller a stake in the continuation of the relationship, this rent gives him an incentive to supply goods (or work effort) of the promised quality when quality is observable to the buyer only on a random basis or after payment for the commodity is made. The dual functions of the price mechanism in the neoclassical model – its allocative role and its role in determining income distribution – are inseparable in models of enforcement rents because prices there play a third role – that of a quality enforcement mechanism. In such models a lump-sum transfer will not, in general, shift an incentive constraint.

6. Other applications

Beyond the literature on incentive compatibility and missing markets, the second theorem of the second best provides insights in a variety of other contexts.

6.1. Tax distortions and the optimal supply of public goods

In public finance, a second-best type of distribution policy will generally have to be pursued in an economy with public goods and a pre-existing distortionary tax system. A wage tax t that provides government with a revenue requirement R is assumed to be one of the data. There is one aggregate individual with utility $v(q, I) + u(G)$, where $v(\cdot)$ is the indirect utility function for private goods, which depends on a price vector q and lump-sum income I, and $u(G)$ are benefits from consumption of the public good. Individuals supply labor, L, which has constant marginal productivity, w.

Suppose first that the public good could be financed in a lump-sum way. Then the condition for attaining the second-best maximum is found as the condition for solving

$$\max_G v(q, I-G) + u(G) + \lambda[twL(q, I-G) - R]$$

and is therefore (assuming $\partial^2 v/\partial I^2 \leqq 0$ and $u'' < 0$)

$$-\frac{\partial v}{\partial I} + u' - \lambda tw \frac{\partial L}{\partial I} = 0.$$

If leisure is a normal good (i.e. $\partial L/\partial I < 0$), then a welfare optimum entails $u' < \partial v/\partial I$. Interpreting $v(\cdot)$ and $u(\cdot)$ as utility functions of two distinct households, the 'private' and the 'public', the correct policy is *not* to equalize the marginal utility of income across households, because income transfers across households shift the second-best constraint.

This insight carries over to the case where public goods are financed by an increase in the wage tax rate. Via the Slutsky decomposition, the effect of the tax increase is a combination of a pure income effect and a substitution (relative price) effect. The substitution effect always reduces the supply of labor and so tightens the second-best constraint, $twL \leqq R$, but this effect is fully (more than fully) offset by the income effect if labor supply is perfectly inelastic (backward bending). In the latter case, providing a public good at a cost of \$1 will increase welfare even when the direct consumption benefits are slightly less than \$1 and the financing is through an increase in the wage tax! This result was established two decades ago by some of the leading public finance economists [Stiglitz and Dasgupta (1971, pp. 158–159), Atkinson and Stern (1974, pp. 122–123)], but an informal survey of 22 public finance economists from first-rank U.S. universities suggests that only a very few understood it or were aware of it [Ballard and Fullerton (1992)]. The authors attribute this blind spot to the very strong tradition in the public finance literature, due to Harberger, that income effects are separable from efficiency effects, a result that is correct only in an economy with no pre-existing distortions.

6.2. Monopoly pricing

In the field of development economics, an application of the second theorem of the second best is suggested by recent work on the micro-structure of rural credit markets that finds that the scope of the monopolistic sector of the credit market depends on the size of the population without land or other collateralizable wealth. In many rural areas of low-income countries, a formal banking sector exists that provides farmers with credit at low interest rates, side by side with an informal commercial credit sector that lends at interest rates many times higher than the formal sector rate. The local moneylenders are at an advantage relative to the formal banking sector: banks can only profitably make loans to individuals with land or other collateral or in a group lending program, whereas loans to farmers without collateral might still be profitable to an informal lender whose proximity to the borrower reduces his monitoring and enforcement costs. There is evidence from some rural areas [see Hoff and Stiglitz (1992) and references therein] that the time-consuming and uncertain process of screening landless farmers creates relationship-specific capital between the moneylender and the borrower that insulates an incumbent lender's market from competitors even when his charges are above the marginal cost of lending. In this view, the distortion induced by monopoly pricing is one that arises only for borrowers who are without collateral. The conditions for attaining the second-best optimum will thus depend on the effect of the distribution of wealth on farmers' dependence on the informal sector in which credit is priced monopolistically.

7. Concluding remarks

Most of the public finance literature treats the scope and structure of markets as exogenous, as emphasized by Hammond (1990). It does not come to grips with the implications of private information *among* transactors in an economy (as distinct from information asymmetries *between* government and individuals). One contribution of this paper has been to show that it is a general result that lump-sum redistributions of wealth have an instrumental value in overcoming barriers to exchange arising from asymmetric information among transactors in a competitive economy. The channels through which such effects work include *countervailing incentives*, *hostages*, and the competitive structure of markets. I have presented examples of effects that would tend to push a social welfare optimum in a direction of greater inequality of wealth, and others that would push it in the direction of greater equality.

Redistributions of wealth (or income) can also cause shifts in second-best constraints through consumption effects if not all households have identical, homothetic preferences. The second theorem of the second best subsumes many results in cost–benefit analysis, such as the question of the optimal supply of public goods, which depend on income effects on consumer behavior in the presence of exogenous distortions.

In all of the examples in this paper, redistributions were lump sum. Obviously, it is rare that governments have instruments for lump-sum redistributions. Thus, governments face a tradeoff between gains from pure wealth effects of redistributions and losses from substitution effects.[13]

This paper has also assumed throughout that resources are in fixed supply. A longstanding hypothesis in development economics is that in poor agricultural economies, income levels influence labor supply through nutritional effects. Under that hypothesis, if productivity is locally concave (convex) in consumption, the economy's aggregate effective labor will go up (down) in response to a small equalizing shift in the distribution of wealth [see Dasgupta and Ray (1986, 1987)].

Thus, a complete welfare analysis of a lump-sum transfer would include (a) equity effects, (b) effects on supply and demand in markets with distorted prices, (c) shifts in incentive constraints, (d) effects on prices in economies with missing markets (pecuniary externalities), (e) institutional responses to imperfect information and missing markets, and (f) labor productivity effects in very poor economies. The focus of this paper has been primarily (c), and the two examples in the body of this paper abstracted from all other effects. I

[13]Hoff and Lyon (1992) provide numerical simulations of a policy that imposes a distortionary tax on labor and returns the revenues by uniform lump-sum grants. The lump-sum grant substitutes for the lack of collateral on the part of some individuals. For plausible assumptions about the compensated labor elasticity, we find that the tax-transfer policy can recover more than 60 percent of the loss in social welfare that is due to the incentive constraint.

have argued that a wide variety of results from the incentive compatibility literature and from cost–benefit analysis can be seen as illustrations of a simple extension of the theory of the second best.

Appendix: Proof of Proposition 1

A financial contract is a vector of payments $\langle Z_0, Z_u, Z_s \rangle$ from the entrepreneur, and capital provision $\langle 0, 1-W^E, 1-W^E \rangle$ by the lender, contingent on the three states of the world the lender can observe – state 0 where no project is undertaken, state u where the project fails, and state s where it succeeds. To simplify the notation, let H^* and h^*, respectively, denote the value of the distribution and density function of p evaluated at p^*; and let EZ denote the expected payment from the entrepreneur:

$$\mathrm{E}Z \equiv [1-H^*][\hat{p}Z_s + [1-\hat{p}]Z_u] + H^*Z_0.$$

The investment and financial contract in competitive equilibrium maximizes the entrepreneur's expected utility (U^E):

$$\max_{p^*, Z_0, Z_s, Z_u} \quad H^*rW^E + [1-H^*]\hat{p}R - EZ - e \tag{A.1}$$

subject to four constraints: the lender's break-even condition,

$$\mathrm{E}Z = r[1-W^E][1-H^*]; \tag{A.2}$$

the entrepreneur's budget constraint in the state of the world that the project fails,

$$Z_u \leqq 0; \tag{A.3}$$

and two incentive constraints relating to (i) the entrepreneur's decision whether to evaluate a project and (ii) his choice of p^*, the minimally acceptable success probability for a project.

The first incentive constraint is

$$H^*rW^E + [1-H^*]\hat{p}R - \mathrm{E}Z - e \geqq rW^E - Z_0 \geqq 0 \quad \text{(NSC)}. \tag{A.4}$$

I call this the no-shirking constraint (NSC) since if, and only if, it is satisfied will the entrepreneur exert effort to evaluate a project and thereby have a positive probability of project success. Using (A.2) this constraint implies

$$s(p^*) \equiv [1-H^*][\hat{p}R - r] - e \geqq -Z_0, \tag{A.4'}$$

where $s(p^*)$ denotes the expected surplus from evaluating a project.

Since p^* is not observable to the lender, p^* must be consistent with the entrepreneur's self-interest. Thus the second incentive constraint is $\partial U^{\mathrm{E}}/\partial p^*=0$, which implies

$$rW^{\mathrm{E}}-Z_0=p^*[R-Z_{\mathrm{s}}]+[1-p^*][-Z_{\mathrm{u}}] \quad (p^*\text{-constraint}). \tag{A.5}$$

The LHS is the entrepreneur's expected gain from not undertaking a project, and the RHS is his expected gain from undertaking the minimally acceptable project.

Assign Lagrange multipliers μ, ψ, α, and γ to (A.2), (A.3), (A.4), and (A.5), respectively. The first-order conditions for p^*, $Z_{\mathrm{s}}-Z_{\mathrm{u}}$, Z_0, and Z_{u} are

$$\mu[r-p^*R]h^*-\gamma[R-Z_{\mathrm{s}}+Z_{\mathrm{u}}]=0, \tag{A.6}$$

$$[\mu-\alpha-1][1-H^*]\hat{p}+\gamma p^*=0, \tag{A.7}$$

$$[\mu-\alpha-1]H^*-\gamma+\alpha=0, \tag{A.8}$$

$$[\mu-\alpha-1][1-H^*]+\gamma-\psi=0, \tag{A.9}$$

where (A.6) is derived using the fact that $\partial U^{\mathrm{E}}/\partial p^*=0$, and then substituting the RHS of (A.5) for the term $rW^{\mathrm{E}}-Z_0$. We will consider two cases.

Case (i). Suppose the NSC (A.4) does not bind, so $\alpha=0$. Then (A.8) reduces to $\gamma=[\mu-1]H^*$ and (A.7) implies $\mu=1$, so that $\gamma=0$ and the p^*-constraint (A.5) does not bind. From (A.6), $\gamma=0$ yields $p^*=p^*_{\mathrm{fb}}$. We now wish to solve for the lowest value of wealth at which the NSC (A.4) does not bind and $p^*=p^*_{\mathrm{fb}}$. To minimize agency costs, set Z_{u} at its maximum feasible value subject to (A.3). Imposing $Z_{\mathrm{u}}=0$, the lender's break-even condition (A.2) implies

$$Z_{\mathrm{s}}=r[1-W^{\mathrm{E}}]/\hat{p}-H^*Z_0/\{[1-H^*]\hat{p}\}. \tag{A.10}$$

Using the above values for Z_{u} and Z_{s}, (A.5) yields the equilibrium relationship between Z_0, p^*, and W^{E}:

$$-Z_0=\{p^*R-r[W+[1-W]p^*/\hat{p}]\}/\{1+p^*H^*/\{\hat{p}[1-H^*]\}\}>0. \tag{A.11}$$

By setting $p^*=p^*_{\mathrm{fb}}$ (which means $p^*R=r$), and using (A.11), we can rewrite (A.4′) as

$$r[1-W^{\mathrm{E}}][1-p^*/\hat{p}]\leqq s(p^*)\{1+p^*H^*/\{\hat{p}[1-H^*]\}\}.$$

The above inequality is equivalent to $W^{\mathrm{E}}\geqq\bar{W}$, where $\bar{W}$ is implicitly defined by

$$r[1-\bar{W}][1-p^*/\hat{p}]=s(p^*)\{1+p^*H^*/\{\hat{p}[1-H^*]\}\}. \tag{A.12}$$

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